

# *Zygomelon zodion*, A New Genus and Species of Bathyal Volute from New Zealand

by

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*Abstract.* *Zygomelon zodion*, a new genus and species of Volutidae, is described from bathyal depths on the Bounty Plateau and in the Bounty Trough, southeastern New Zealand. It is referred to the tribe Alcithoini of the subfamily Zidoninae on the basis of anatomical and radular features. *Zygomelon zodion* can most easily be distinguished from species of *Alcithoe* H. & A. Adams, 1853, by the presence of two rather than four or more columellar folds. Conchological similarities between *Zygomelon* and the genus *Miomelon* Dall, 1907, of the subfamily Odontocymbiolinae lead us to hypothesize that the subfamily Odontocymbiolinae differentiated from the zidonine tribe Alcithoini in the Wedellian Province during the Paleogene.

## INTRODUCTION

Deep-sea dredgings during 1979 off southeastern New Zealand yielded rich collections of mollusks, including a number of species new to science, among them the new volute described herein. With a bathymetric range of 734-1386 m, it is the deepest-living volute known from the New Zealand region. Based on features of its anatomy and radular morphology, we include this new species in the subfamily Zidoninae. However, the combination of conchological and anatomical features precludes the inclusion of this species in any genus presently known. We propose a new genus, to include this new species as well as a closely related species from the Eocene of Antarctica. Based on new morphological and paleontological data, we evaluate and expand hypotheses on the relationships and paleobiogeography of the volutid subfamilies Zidoninae and Odontocymbiolinae.

Abbreviations: NMNZ—Museum of New Zealand, Wellington; NZOI—National Institute of Water and Atmospheric Research, Wellington; USNM—National Museum of Natural History, Smithsonian Institution, Washington, DC.

## SYSTEMATICS

Family VOLUTIDAE Rafinesque, 1815

Subfamily ZIDONINAE Pilsbry and Olsson, 1954

Tribe Alcithoini Pilsbry and Olsson, 1954

*Zygomelon* Harasewych & Marshall, gen. nov.

**Type species:** *Zygomelon zodion*, new species [described herein].

**Diagnosis:** Shell small to large (to 106 mm), stout, strongly to weakly shouldered, with prominent axial and obscure spiral sculpture. Outer lip smooth, thin. Columella with two columellar folds and siphonal fold. Siphonal fasciole weak. Operculum absent. Siphonal appendages paired, long, cylindrical. Cephalic lappets broad. Accessory salivary glands long, loosely wound around salivary glands. Radula uniserial, tricuspid, with lateral cusps broader, shorter than central cusp. Pallial sperm duct forming groove with fused edges that runs to tip of short, bluntly rounded penis.

Table 1

*Zygomelon zodion* Harasewych & Marshall, gen. & sp. nov. Measurement of shell and radular characters. Linear measurements in mm.  $n = 4$ . HT = Holotype (Figure 1), Paratype, NZOI P-957 (Figure 4), Paratype, NMNZ M.117892 (Figure 2), Paratype, NZOI P-958 (Figure 3).

	Specimen			
	HT	NZOI P-957	NMNZ M.117892	NZOI P-958
Sex	♀	♂	♀	juvenile
Shell length (SL)	50.25	43.01	28.71	9.22
Aperture length (AL)	27.92	22.70	16.42	6.17
AL/SL	0.55	0.53	0.57	0.67
Total number of whorls	6.5	6.0	5.25	2.25
Spire angle	41°	32°	40°	31°
Axial ribs body whorl	15	15	14	n/a
Axial ribs first teleoconch whorl	11	13	14	n/a
Radula length (RL)	0.14	0.14	0.12	0.09
Number of radular teeth	57	54	47	34

**Etymology:** *zygosis* Gr. a joining. + *melon* Gr. apple. [used as suffix for many volute genera e.g., *Adelomelon*, *Miomelon*, *Teremelon*, etc.]

*Zygomelon zodion* Harasewych & Marshall, sp. nov.

Figures 1–13, Table 1

**Diagnosis:** Shell small (to 50.2 mm), greenish tan, stout. Protoconch large, of less than two smoothly rounded whorls. Transition to teleoconch distinct. Teleoconch of up to 5¾ whorls shouldered in females, rounded in males. Eyes absent.

**Description:** Shell (Figures 1–4) small (to 50.2 mm), thin, biconic, with fusiform spire, rounded anterior. Protoconch (Figures 6, 7) large, of 1¾ whorls, increasing in diameter from 1.3 mm to 2.9 mm in 1¼ whorls, constricting slightly thereafter. Transition to teleoconch forming subtle but distinct varix (Figure 7, arrow). Teleoconch of up to 5¾ whorls, convex, strongly shouldered in females (Figures 1, 2), weakly shouldered in juveniles (Figure 3) and adult males (Figure 4). Suture adpressed, early whorls narrowly canaliculate. Axial sculpture of 11–15 broad, equally spaced, inflated, slightly prosocline ribs, entirely traversing early whorls, prominent on shoulder, absent along anterior portion of adult whorl. Spiral sculpture of fine spiral threads present on early whorls, obscure or absent in larger specimens. Aperture ovate. Outer lip smooth, porcellaneous, thin, not flared. Inner lip consisting of convex parietal region and axial columella with two columellar folds set obliquely to siphonal fold. Anteriormost columellar fold most pronounced, posteriormost present in juveniles, be-

coming reduced or absent in larger specimens. Siphonal fold prominent, crossing coiling axis of shell. Surface of columella with minute pustules (Figure 5). Siphonal canal shallow, wide. Siphonal fasciole weak, inconspicuous. Periostracum thin, yellowish. Shell greenish tan. Aperture yellowish tan to brown.

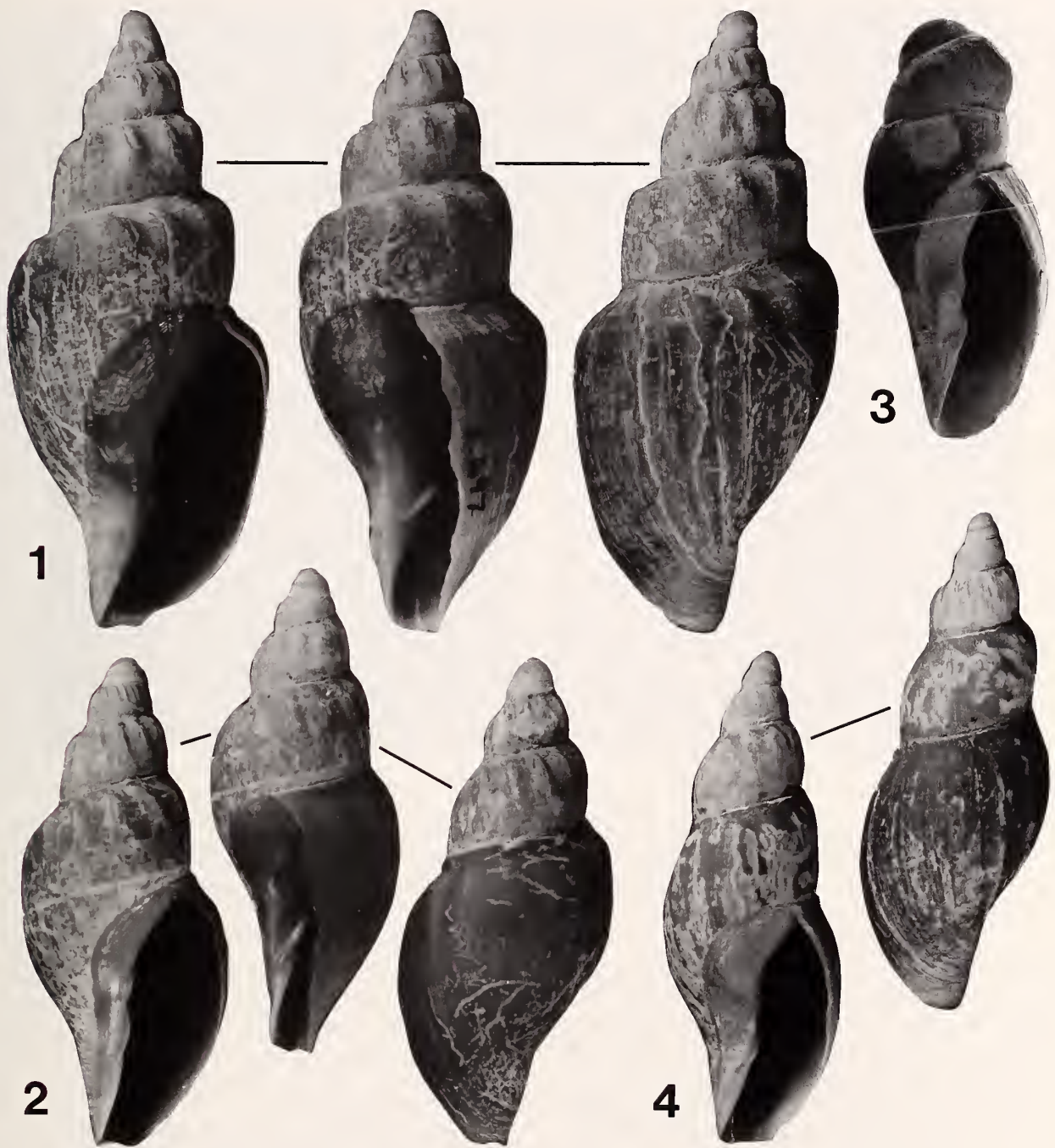
**External anatomy.** Soft tissues comprising three whorls, mantle cavity spanning ⅔ whorl, kidney ⅓ whorl, digestive gland and gonad 1⅓ whorls. Foot ( $L/W \gg 2$ ) broad, rounded anteriorly, tapering posteriorly. Operculum absent. Animal uniformly yellowish tan. Siphon (Figure 10) short, muscular. Siphonal appendages (Figure 10, sa) paired, symmetrical, emerging from the base of the siphon and spanning half its length. Head broad, with short, tubular tentacles (Figure 10, t) flanking hood over rhynchostome. Cephalic lappets (Figure 10, cl) broad, semi-circular. Eyes absent.

**Mantle cavity.** Arrangement of mantle cavity organs as in *Alcithoe arabica* (Gmelin, 1791) (see Ponder, 1970). Mantle edge thin, smooth. Osphradium bipectinate, with 55 equally broad leaflets above and 48 below ganglion. Ctenidium slightly narrower, 1½ times as long as osphradium. Hypobranchial gland thin, transversely pleated, occupying dorsal midsection of mantle cavity, covering portions of the rectum and reproductive organs, producing purple secretion. Pericardium embedded in left anterior wall of kidney. Ventricle only slightly larger than auricle.

**Alimentary system** (Figure 11). Proboscis short, broad, extremely muscular, with retractor muscles attached to walls of cephalic hemocoel. Mouth triangular. Buccal mass small. Radular ribbon short (to 7.0 mm), uniserial, with 34–57 tricuspid teeth. Cusps broadly triangular in adults (Figure 8), joining proximally to span basal plate. Central cusp indented beneath tip of anterior adjacent tooth, lateral cusps shorter, broader than central cusp, forming slightly more acute angle with radular membrane (Figure 8). Radula of juvenile specimen (Figure 9) differing from that of adult in having cusps concentrated at midsection of basal plate, oriented nearly parallel to radular membrane. Central cusps lacking indentation, lateral cusps narrower, almost as long as central cusp. Accessory salivary glands (Figure 11, asg) tubular, convoluted, distally expanded, overlying dorsal surfaces of salivary glands (Figure 11, sg). Ducts of accessory salivary glands (Figure 11, dasg) joining prior to entering buccal cavity ventrally. Ducts of salivary glands embedded in esophagus anterior to small, indistinct valve of Leiblein (Figure 11, vl). Gland of Leiblein (Figure 11, gl) large, convoluted, filling posterior half of cephalic hemocoel. Stomach with broad, transversely pleated caecum. Intestine short, rectum (Figure 12, r) broad, rectal gland (Figure 12, rg) greenish, narrow, spanning distal third of rectum. Anus (Figure 12, a) simple.

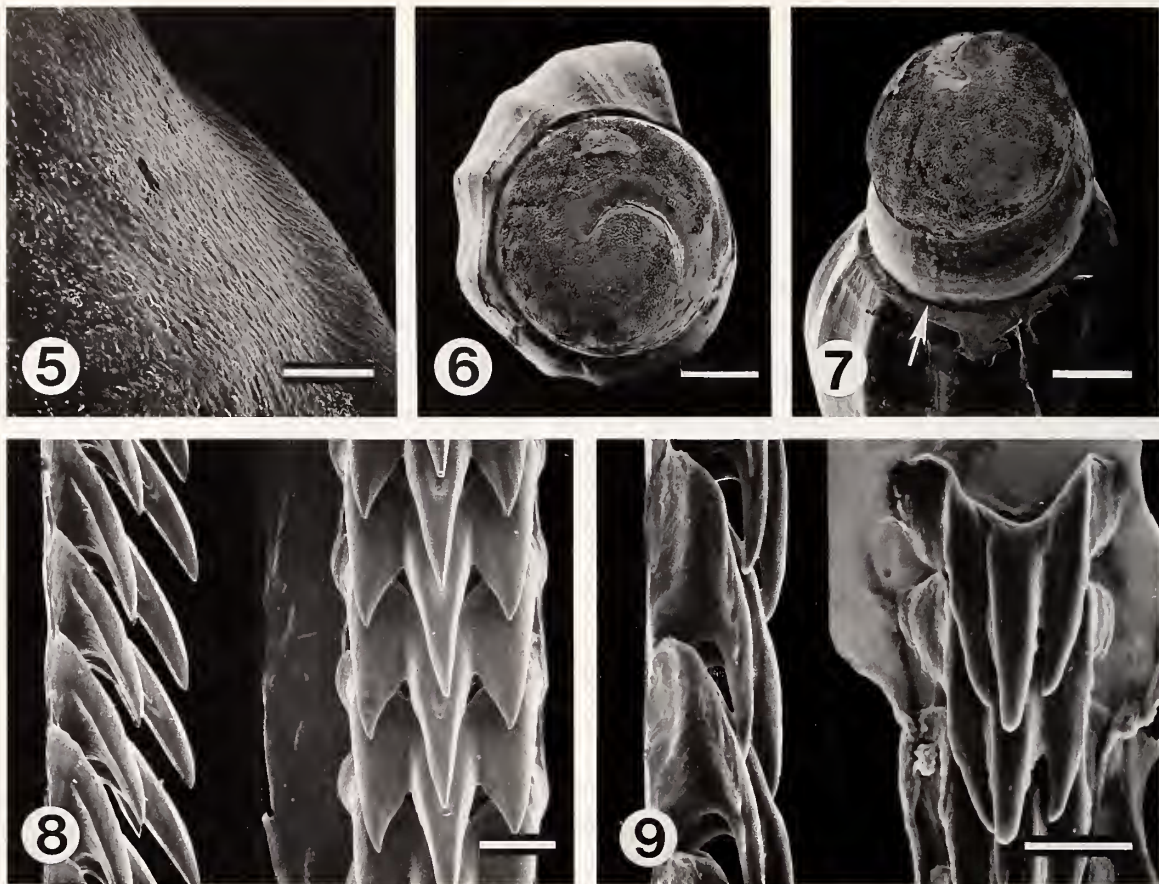
**Female reproductive system** (Figure 12). Ovary whitish, lining columellar side of digestive gland. Oviduct (Figure 12, od) thin, leading from ovary to right rear corner of mantle cavity, entering anterior ventral end of large al-





Figures 1-4

*Zygomelon zodium* Harasewych & Marshall, gen. & sp. nov. 1. Holotype, female, NZOI H-617, Bounty Plateau, 48°30.5'S, 178°18.0'E, in 734-1012 m.  $\times 1.9$ . 2. Paratype, female, NMNZ M.117892, NZOI station S154, Bounty Trough, 45°24.2'S, 173°59.8'E, in 1373 m.  $\times 2.7$ . 3. Paratype, NZOI P-958.  $\times 7.0$ . 4. Paratype, NZOI P-957, male, both from NZOI station S153, Bounty Trough, 45°21.2'S, 173°35.8'E, in 1386 m.  $\times 1.8$ .



Figures 5-9

*Zygomelon zodion* Harasewych & Marshall, gen. & sp. nov. Paratype, NZOI P-958 (specimen in Figure 3). 5. Columella adjacent to anteriormost fold. Scale bar = 100  $\mu\text{m}$ . 6. Apical and 7. oblique views of protoconch. Arrow denotes varix at transition to teleoconch. Scale bars = 50  $\mu\text{m}$ . 8. Lateral and dorsal views of radula of the holotype (Figure 1). Scale bar = 100  $\mu\text{m}$ . 9. Lateral and dorsal views of radula of juvenile specimen in Figure 3 (paratype, NZOI P-958). Scale bar = 100  $\mu\text{m}$ .

bumen gland (Figure 12, ag) adjacent to right ventral kidney wall. Ingesting gland (Figure 12, ig) joining pallial oviduct at rear of the mantle cavity. Capsule gland (Figure 12, cg) short, broad, enveloped, together with rectum, rectal gland, in connective tissue and muscular sheath. Capsule gland joining nearly spherical bursa copulatrix (Figure 12, bc), with female opening (Figure 12, fo) at anteriormost end.

**Male reproductive system.** Testes lining inner edge of digestive gland, emptying through tubular duct passing along pericardium prior to entering mantle cavity and expanding to form prostate gland. Prostate gland broader, slightly shorter than penis, opening to mantle cavity via ventral slit. Pallial vas deferens tubular, running anteriorly along mantle cavity wall, forming groove with fused edges upon descending to mantle cavity floor. Groove extending to base of penis. Penis (Figure 10, p) short ( $< \frac{1}{2}$  mantle cavity length), ovate in section, tapering gradually to blunt-

ly rounded distal end. Penial duct (Figure 10, pd), a fused slit, running along inner edge of penis from base to tip.

**Kidney.** Kidney large, typical of volutids as exemplified by *Alcithoe arabica* (see Ponder, 1970:fig. 33). Nephridial gland, adjacent to the pericardium, comprising approximately  $\frac{1}{3}$  kidney width.

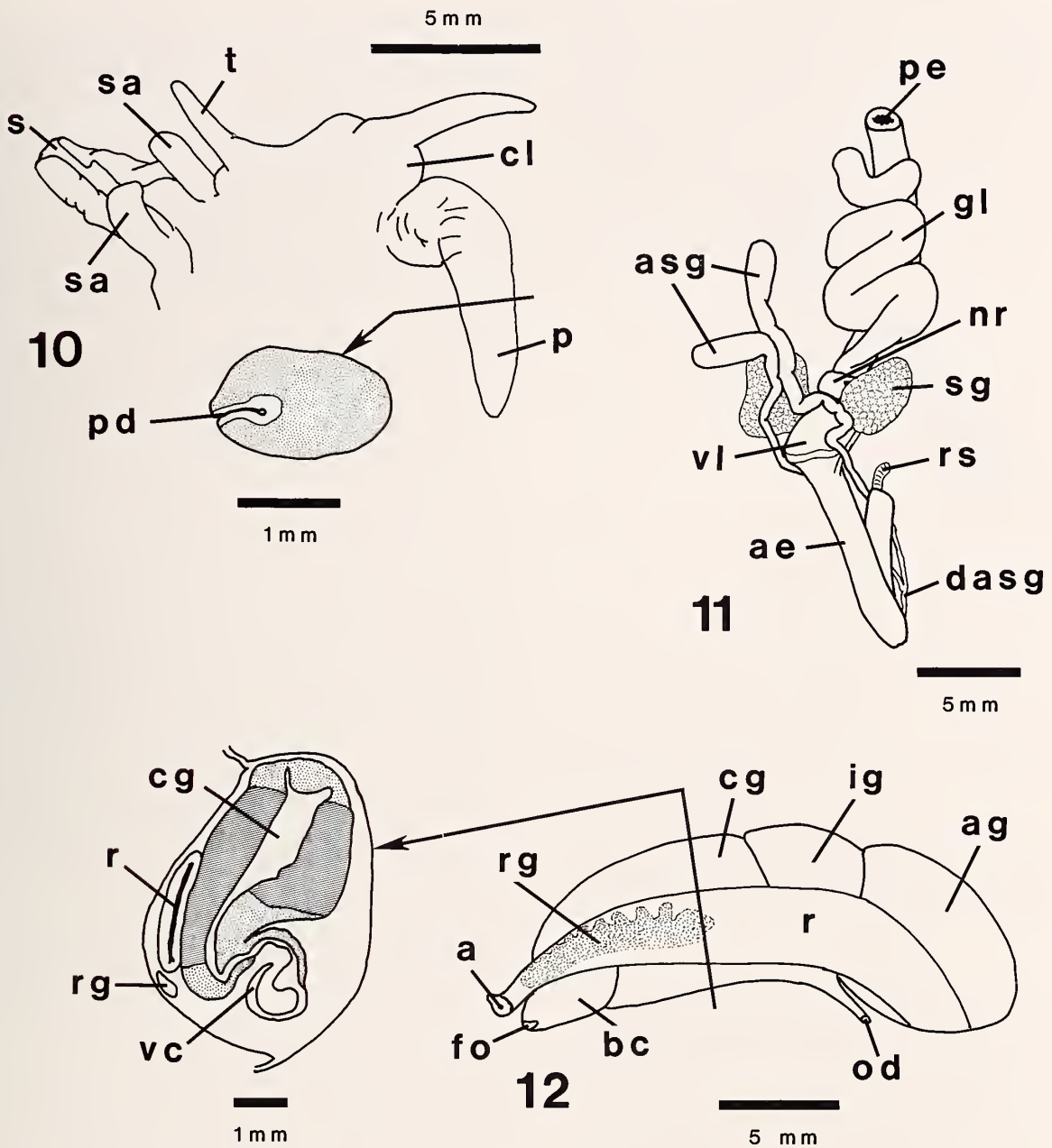
**Nervous system.** Supraesophageal and right pleural ganglia fused, corresponding to nervous system type 2 (Ponder, 1970:159).

**Etymology:** *zodion* Gr.—a small animal.

**Type locality:** Bounty Plateau, southeastern New Zealand, 48°30.5'S, 178°18.0'E, 734–1012 m, NZOI stn I697, 19 March 1979.

**Material examined:** Holotype, female, NZOI H-617, from the type locality. Paratypes (2), NMNZ M.117892, Paratypes (2), NZOI P-955,956, Paratype, USNM





Figures 10-12

*Zygmelon zodion* Harasewych & Marshall, gen. & sp. nov. 10. Dorsal view of head and penis, with siphon reflected to left. 11. Anterior alimentary system. 12. Female glandular oviduct. Key: a, anus; ae, anterior esophagus; ag, albumen gland; asg, accessory salivary gland; bc, bursa copulatrix; cg, capsule gland; cl, cephalic lappet; dasg, duct accessory salivary gland; fo, female opening; gl, gland of Leiblein; ig, ingesting gland; nr, nerve ring; od, oviduct; p, penis; pd, penial duct; pe, posterior esophagus; r, rectum; rg, rectal gland; rs, radular sac; s, siphon; sa, siphonal appendage; sg, salivary gland; t, tentacle; vc, ventral channel; vl, valve of Leilein.



Figure 13

Map of New Zealand region showing distribution (stars) of *Zygomelon zodion* Harasewych & Marshall, gen. & sp. nov. 200 and 1000 m contours indicated.

860379, Bounty Trough, 45°24.2'S, 173°59.8'E, 1373 m. NZOI stn. S154, 27 October 1979. Paratype, male, NZOI P-957, Paratypes (2), juveniles, NZOI P-958, Bounty Trough, 45°21.2'S, 173°35.8'E, 1386 m, NZOI stn. S153, 27 November 1979.

**Distribution:** (Figure 10). This new species is known at present from three stations on the Bounty Plateau and in the Bounty Trough. The bathymetric range is 734–1386 m.

**Comparative remarks:** The shell of *Zygomelon zodion* most closely resembles that of the odontocymbioline volutes *Miomelon eltanini* Dell, 1990, which ranges from the Falkland Islands to the Bellinghousen Sea at depths of 646–1971 m, and *Miomelon philippiana* (Dall, 1890) from comparable depths off the coast of Chile. There is a particularly close correspondence in the morphology of the protoconchs of these species as well as in the number and relative prominence of their columellar folds. However, *Zygomelon zodion* cannot be included in *Miomelon* as it is clearly referable to the subfamily Zidoninae, lacking the

following features that have been reported in all species of Odontocymbiolinae studied to date: a “fanglike” radula with well-separated cusps that emerge from anterior margins of rectangular basal plates; a stomach with a broad, tubular anterior region; accessory salivary glands that are intertwined with and embedded in the salivary glands; and a penis with a terminal papilla (Harasewych, 1987:7).

Of the Recent (Weaver & du Pont, 1970; Powell, 1979; Poppe & Goto, 1992) and fossil (Beu & Maxwell, 1990) New Zealand volutes, *Zygomelon zodion* is superficially similar to species of the genus *Alcithoe*, especially small forms of *Alcithoe wilsonae* (Powell, 1933), but it lacks the four strong, oblique columellar folds characteristic of that genus. Although it differs from *Zygomelon zodion*, in having a proportionally larger aperture, *Pachymelon* (*Palomelon*) *suropsilos* Stilwell & Zinsmeister, 1992, from the late Eocene of Seymour Island, Antarctica, is similar in that it “reveals slight evidence of two columellar folds” (Stilwell & Zinsmeister, 1992:145). The presence of two columellar folds precludes the inclusion of *P. suropsilos* in *Pachymelon* Marwick, 1926 (Type species: *Waihaioa amoriaformis* Marwick, 1926; Early Miocene, New Zealand), and indicates that it is more appropriately assigned to *Zygomelon*. The type species of *Palomelon* Finlay, 1926 (*Cymbiola lutea* Watson, 1882; Recent, New Zealand) is a typical *Alcithoe* species, and we follow Dell (1978) in treating this subgenus as a synonym of *Alcithoe*.

## DISCUSSION

In their revision of the family Volutidae, Pilsbry & Olsson (1954) erected the subfamily Alcithoinae, further subdividing it into the tribes Alcithoini, Pachycymbiolini, and Zidonini (as Alcithoides, Pachycymbiolides, and Zidonides respectively). As originally proposed, Alcithoini contained Recent and fossil genera from Australia, New Zealand, and India; the Pachycymbiolini were restricted to South America and the eastern Pacific, whereas Zidonini comprised a single monotypic genus from the southern Atlantic. Clench & Turner (1964:147) pointed out that Zidoninae H. & A. Adams, 1853 was a senior synonym of Alcithoinae, as both contained the genus *Zidona* H. & A. Adams, 1853. They did not modify the concept of the subfamily other than to expand its characterization to include a number of anatomical features. In their classification of the caenogastropods, Ponder & Warén (1988: 306) listed the subfamily Alcithoinae as separate from the Zidoninae, without discussion.

Apart from the geographic separation, the primary differences between Alcithoini and Pachycymbiolini appear to be in early development. The protoconchs of species of Alcithoini have a “relatively large nucleus, often high or elevated, but composed of a few whorls, of which the initial one is already quite large” (Pilsbry & Olsson, 1954:281). The protoconchs of Pachycymbiolini, on the other hand, usually have bulbous, secondarily calcified whorls with pointed calcarella (Clench & Turner, 1964:136). Both

groups have large, nearly spherical egg capsules, although calcified egg capsules have been reported only in Alcithoini (Powell, 1979:211).

Early whorls of Zidonini are small, lack a calcarella, and are covered by a spinelike callus. Animals have an enlarged left mantle lobe that completely envelopes the shell and produces a microscopically pustulated overglaze on the outer surface of the shell. Although the tribe originally contained only the geographically restricted, monotypic genus *Zidona*, species of *Iredalina* Finlay, 1926, and *Provocator* Watson, 1882, also share these features and extend the range of the tribe throughout the Southern Ocean.

On the basis of anatomical similarities, Harasewych (1987:8) suggested that the Odontocymbiolinae was derived from the Zidoninae, and that the two subfamilies are closely related. The conchological similarities between *Zygomelon* and *Miomelon*, a genus within Odontocymbiolinae, lead us to further restrict the ancestor of Odontocymbiolinae to the tribe Alcithoini, either to *Zygomelon* or to a closely related genus.

The zoogeographic hypothesis that Odontocymbiolinae radiated in the Wedellian Province during the Paleogene (Harasewych, 1987:8) is supported by the finding of a progenitor of *Miomelon* in the Late Eocene-Early Oligocene of Seymour Island. The geographic distribution of the Pachycymbiolini suggests that this group also radiated in the Weddellian Province (Zinsmeister, 1979, 1982) after the separation of New Zealand at the end of the Early Paleocene. Inferences about the age and biogeography of Zidonini must await clarification of the relationships between *Zidona*, *Provocator* and *Iredalina*.

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